

New records of lichenized and lichenicolous fungi in Scandinavia

Martin Westberg¹, Einar Timdal², Johan Asplund³, Mika Bendiksby⁴,
Reidar Haugan², Fredrik Jonsson⁵, Per Larsson⁶, Göran Odelvik¹,
Mats Wedin¹, Ana M. Millanes⁷

1 Department of Botany, Swedish Museum of Natural History, P.O. Box 50007, SE-104 05 Stockholm, Sweden **2** Natural History Museum, University of Oslo, P.O. Box 1172 Blindern, NO-0318 Oslo, Norway **3** Department of Ecology and Natural Resource Management, Norwegian University of Life Sciences, P.O. Box 5003, NO-1432, Ås, Norway **4** NTNU University Museum, Norwegian University of Science and Technology, 7491 Trondheim, Norway **5** Alsens-Ede 227, SE-830 47 Trångsviken, Sweden **6** Nordiska museet, Julita gård, SE-643 98 Julita, Sweden **7** Departamento de Biología y Geología, Física y Química Inorgánica, Universidad Rey Juan Carlos, C/ Tulipán s.n. E-28933 Móstoles, Spain

Corresponding author: Martin Westberg (martin.westberg@nrm.se)

Academic editor: G. Rambold | Received 24 September 2015 | Accepted 29 October 2015 | Published 13 November 2015

Citation: Westberg M, Timdal E, Asplund J, Bendiksby M, Haugan R, Jonsson F, Larsson P, Odelvik G, Wedin M, Millanes AM (2015) New records of lichenized and lichenicolous fungi in Scandinavia. MycoKeys 11: 33–61. doi: 10.3897/mycokeys.11.6670

Abstract

Fourteen species of lichenized or lichenicolous fungi are reported new to either Norway or Sweden or both countries. Several of these are rare and almost unknown. The reported species are: *Acarospora insignis* (new to Norway), *A. pyrenopsoides* (Norway, Sweden), *A. versicolor* (Norway), *Calvitimela perlata* (Sweden), *Lecidea degeliana* (Sweden), *Nephroma helveticum* (Sweden), *Peltula placodizans* (Norway), *Phacographa protoparmeliae* (Norway), *Rhizocarpon pycnocarpoides* (Norway, Sweden), *Sarcogyne algoviae* (Sweden), *Sarcogyne hypophaeoides* (Norway, Sweden), *Tephromela grumosa* (Norway), *Tremella lobariacearum* (Norway) and *Tremella wirthii* (Sweden). In addition *Cladonia albonigra* is confirmed from Sweden. *Sarcogyne hypophaeoides* is lectotypified and is also reported new to Austria.

Key words

Acarosporaceae, barcode, floristics, ITS, lichens

Introduction

Although studies of the biodiversity in Scandinavia have a long and continuous tradition, several thousands of species remain to be discovered, many of which are likely to be common. Among many of those discovered, almost nothing is known about where they occur, how they live and what their functional roles in the ecosystems are. To explore this poorly known biodiversity, the Swedish Taxonomy Initiative (STI) was established in 2002, with the aim to have all multicellular plants, fungi and animals in Sweden identified and described. Numerous taxonomic projects have been funded by the STI to investigate poorly known groups of organisms. Since 2002, almost 2000 species have been found new to Sweden and almost 1000 are new to science (Sundin 2014). In 2009, a similar project was established in Norway (the Norwegian Taxonomy Initiative, NTI), aimed at mapping all organisms in the country. Although the NTI does not provide funding for taxonomic research-projects, around 260 new species to science had been discovered in Norway until 2013 and the number of species new to Norway was approaching 1200 (<http://www.artsdatabanken.no/Article/Article/133228>). The two countries have signed a declaration of cooperation to increase the knowledge of and level of competence on biodiversity in Scandinavia, and collaborative projects have emerged. Several projects in both countries have focused on groups of lichenized and lichenicolous fungi, such as Acarosporaceae (funded by STI), lecideoid lichens (NTI, STI), Tremellales (STI), etc. During the last three years, lichen research groups in Oslo and Stockholm have collaborated and arranged workshops for lichenologists involved in these projects and beyond. Crustose, saxicolous lichens are in general very poorly known. Here, we add ten saxicolous lichens to the Scandinavian flora, mainly found in the still poorly investigated montane areas of Scandinavia. Also new macrolichens are continuously discovered in Scandinavia (Frödén 2010, Hultengren et al. 2011, Klepsland 2013, Klepsland and Timdal 2010) and here we report *Nephroma helveticum* new to Sweden, a rare and declining species in Europe that needs attention and possible conservation actions. In addition we confirm the presences of *Cladonia albonigra* in Sweden. Lichenicolous fungi are understudied and a lot of research is needed on this group (Ihlen and Wedin 2008). We have found three new species to the Nordic countries, one ascomycete, *Phacographa protoparmeliae* and two heterobasidiomycetes, *Tremella lobariacearum* and *T. wirthii*. These new records were collected during the last field seasons by some of the people involved in the different research projects funded by the STI and the NTI.

Material and methods

Material. We studied material collected during field surveys (2011–2014) funded through STI and NTI projects as well as specimens of the same species on loan from various herbaria (GB, GZU, LD, O, S, STU, UPS). All specimens collected during these field trips are deposited in the herbaria O and S.

Table 1. List of sequenced specimens with Accession numbers in the European Nucleotide Archive or GenBank.

| Species | Origin | Voucher | Acc. No. (ITS) |
|-----------------------------------|------------------------|-------------------------------------|----------------|
| <i>Acarospora insignis</i> | Norway, Oppland | Haugan 10022 (O L-173397) | LN890273 |
| | Norway, Oppland | Westberg (S F265207) | LN890274 |
| <i>Acarospora pyrenopsoides</i> | Norway, Aust-Agder | Timdal 11308 (O L-163369) | LN890275 |
| <i>Acarospora versicolor</i> | Norway, Buskerud | Westberg 08-092 (S F268460) | LN890276 |
| | Norway, Oppland | Westberg 08-205 (S F268463) | LN890277 |
| <i>Nephroma helveticum</i> | Sweden, Västerbotten | Jonsson 4200 (UPS L-193714) | LN890278 |
| | Norway, Oppland | Klepsland JK11-L559 (O L-181601) | KT800006 |
| | Norway, Buskerud | Hofton 13176 (O L-196491) | KT800007 |
| <i>Rhizocarpon pycnocarpoides</i> | Norway, Sør-Trøndelag | Bendiksby et al. 12630 (O L-179560) | KR780560 |
| | Norway, Oppland | Rui & Timdal 12665 (O L-179903) | KT800002 |
| | Norway, Buskerud | Rui & Timdal 12854 (O L-184267) | KT800003 |
| | Norway, Nordland | Haugan 11125 (O L-183808) | KT800004 |
| | Norway, Nord-Trøndelag | Haugan 11128 (O L-183810) | KT800005 |
| <i>Tephromela grumosa</i> | Sweden, Bohuslän | Haugan 11501 (O L-184061) | KR303667 |

Morphology. Macromorphological traits were observed using a Zeiss Stemi 2000-C dissecting microscope. Microscopical examinations were carried out using squash preparations, hand-cut sections and freezing microtome sections cut at 16 µm. The preparations were observed in distilled water, lactophenol cotton blue, or 10% KOH (K). Microscopic structures in heterobasidiomycetes were studied using handmade sections stained with Phloxin (1% in water) after pre-treatment with KOH (5%), following the methods of Diederich (1996), and observed with a Zeiss Axioscope-2 microscope. Macro- and microscopic photographs were taken with a Nikon Coolpix 995 camera fitted to both microscopes or with a Nikon D300 with a macrolens with bellows. The macrophotos were processed using focus stacking with the programs Helicon Focus and Combine ZP.

Secondary chemistry. Selected specimens were examined by thin-layer chromatography (TLC), performed in accordance with the methods of Culberson (1972), as modified by Menlove (1974) and Culberson and Johnson (1982).

DNA barcoding. Some specimens (Table 1) were DNA barcoded for the nuclear ribosomal internal transcribed spacer region (ITS) through the Norwegian Barcode of Life project (<http://www.norbol.org/>) or projects funded by the STI.

The species

Acarospora insignis H.Magn, 1924

MycoBank: MB 375596

Acarospora insignis H.Magn. Svensk Bot. Tidskr. 18: 329. 1924.

Holotype. SWEDEN. Härjedalen: Viken. 1878, *P. J. Hellbom* (GB 0129823!). TLC: gyrophoric acid.

Distribution. New to Norway. This species has until now only been known from the type collection from central Sweden. Magnusson (1935) also mentioned a specimen from East Greenland. At first glance it appears to be an odd form of the common and well-known *A. fuscata* with pale brown to reddish brown areoles and a black lower surface that is typically spreading onto the edges of the upper surface (Fig. 1). The C+ red reaction of the cortex (gyrophoric acid) is also present in *A. fuscata*. However, the round, mostly scattered areoles with a single round apothecium and a very low hymenium, only between 50–65 µm tall, identifies *A. insignis*. A preliminary analysis of ITS sequences indicates that it is a close relative to the North American species *A. thamnina* (ID of specimens in GenBank of that species was confirmed by Kerry Knudsen, pers. comm.).

The Norwegian specimens were both collected on siliceous boulders in open spruce forests. The type specimen grows on *Aspicilia cinerea* and Magnusson (1924) concluded that it is a saprophyte. However, the newly found specimens do not grow in direct association with other species. Among other species seen in the specimens, *Aspicilia* cf. *cinerea*, *Rhizocarpon grande* and *Trapelia obtegens* were noted.

Specimens examined. NORWAY. Oppland: Lillehammer, Døsgrenda, between Kinnlia and Åsen, alt. 500 m, 61°05.21'N, 10°20.32'E. 1 June 2011, Haugan 10022 (O L-173397); Lom municipality, Runningsgrenda, Klypa, 61,7236°N, 8,0262°E. 28 June 2013, Westberg (S F265207), TLC: gyrophoric acid.

Acarospora pyrenopsoides H.Magn, 1926

MycoBank: MB 375684

Acarospora pyrenopsoides H.Magn. Acta Horti Gothob. 2: 74. 1926.

Holotype. GREENLAND. Nennese. [undated], *J. Vahl* (UPS L-067474!).

Distribution. New to Norway and Sweden. This is another poorly known species that has received very little attention since Magnusson (1926) discovered it. It has until now been known from scattered records from Greenland, Germany, Finland and Austria (Magnusson 1935, Wirth et al. 2013). It has also been reported from Denmark and Canada but those finds are considered erroneous (Søchting and Alstrup 2008, Knudsen and Kocourková 2010). This is a characteristic species that has a thallus composed of rounded, fairly large squamules (fertile squamules 0.5–3 mm wide), with an incised or almost lobate margin (Fig. 2). The upper surface is flattened with a brownish grey colour. The lower side as well as the steep, vertical sides of the squamules are jet black and somewhat shiny. The apothecia are immersed, at first deeply sunken but later almost level with the thallus. The disc is brown, somewhat shiny and can become somewhat uneven in larger apothecia. Magnusson (1926) thought that the apothecia resembled those in certain species of *Pyrenopsis* from which the epithet is derived. The diagnostic characters include a thin poorly delimited cortex (10–15 µm), an uninterrupted algal layer, a tall (120–140 µm), euamyloid (I+ blue), hymenium and narrow spores (4–5 × 1.5 µm). *Acarospora pyrenopsoides* is a peculiar *Acarospora* not similar to any other species

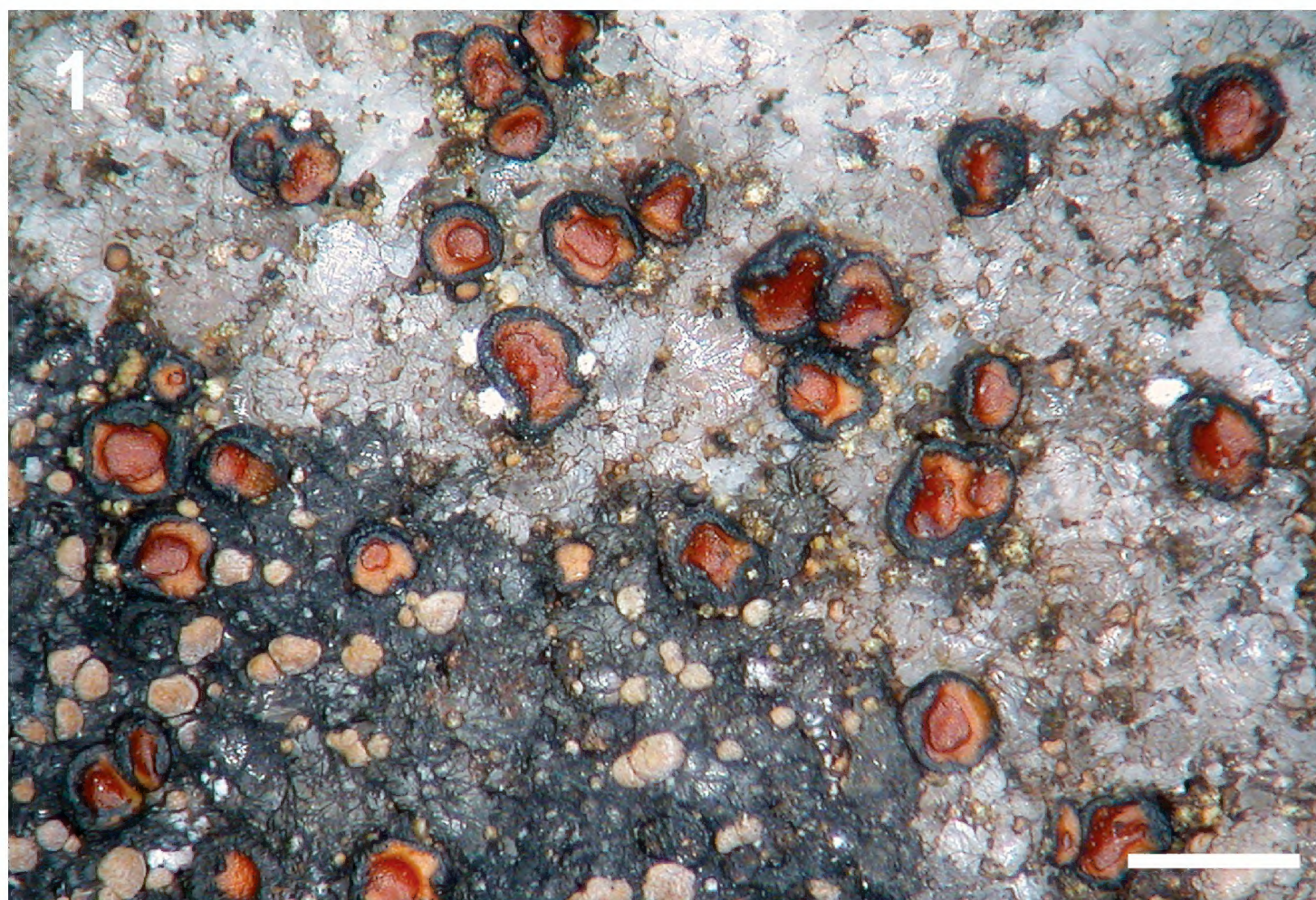


Figure 1. *Acarospora insignis* (O L-173397). Scale: 1 mm.



Figure 2. *Acarospora pyrenopsoides* (O L-163369). Scale: 1 mm.

in the genus. Magnusson (1926) considered its position in the genus to be isolated because of its unusual characters but speculated that it may be closest to *A. nitrophila*. The specimen from Norway was sequenced and a preliminary analysis (not shown) indicates that it belongs to a group with *A. peliscypha*, *A. molybdina* and *A. wahlenbergii* within *Acarospora* in a restricted sense (see Westberg et al. 2015). There is however, as far as we can see, no particular character of its morphology that indicates this relationship.

Acarospora pyrenopsoides appear to prefer humid localities. The locality in Norway reported here, lies near a waterfall where the species was found on sloping rocks. It is the only European site of the North American *Rhizocarpon bolanderi* (Tuck.) Herre, and was found during an inventory of that species. The two Swedish localities are located on or near lakeshores in the province of Värmland in central Sweden.

Specimens examined. NORWAY. Aust-Agder: Valle, Hallandsfossen. 28 July 2010, Timdal 11308 (O L-163369); SWEDEN. Värmland: Stora Kil par., W steep towards the lake Fryken, S of Prästhamna. 15 May 1960, Sundell 1915a (UPS L-126715); Trankil par., Guppviksön. 22 Aug. 1976, Sundell 11217 (UPS L-515137).

Acarospora versicolor Bagl. & Carestia, 1863

MycoBank: MB 375773

Acarospora versicolor Bagl. & Carestia. Comm. Soc. Critt. Ital. 1: 440. 1863.

Type. ITALY. Piemonte. *F. Baglietto* s.n. (the location of the type is unknown according to Knudsen et al. in press).

Distribution. New to Norway. *Acarospora versicolor* is widespread on both siliceous and calcareous rocks in Europe and western Asia and is in the Nordic countries known from one locality in Finland and one unconfirmed report from Denmark (Alstrup et al. 1990, Knudsen et al. in press).

Acarospora versicolor belongs to the morphological group of brown *Acarospora* species lacking secondary metabolites. There are many names and many taxonomical problems in this group but *A. versicolor* was recently discussed and described in detail by Knudsen et al. (in press). *Acarospora versicolor* is identified by its white pruinose thallus and the negative C-reaction of the cortex. The thallus in *A. versicolor* is areolate and can become somewhat squamulose when well developed. It is mostly recognized by the presence of a white pruina on at least parts of the thallus (Fig. 3), but the pruina is sometimes lacking completely. The apothecia usually have a distinct margin and both the disc and the margin are typically darker than the thallus, sometimes almost black. It may then remind of a small form of *A. badiofusca* but the apothecia are not sessile as the mostly are in that species and there are several other character separating these species.

The Norwegian specimens reported here all grow calcareous rocks in sun-exposed habitats in the southern parts of the country. It is as far as we know the only one in this group of species in Scandinavia growing on calcareous rocks. However, elsewhere in Europe it also grows on non-calcareous rocks (Knudsen et al. in press).



Figure 3. *Acarospora versicolor* (S F268463). Scale: 1 mm.

Specimens examined. NORWAY. Buskerud: Hole, west side of the island Storøya, 60,04685°N, 10,2376°E. 8 June 2008, Westberg 08-092 (S F268460); Oppland: Dovre, Hjelle, 62°03.21'N, 9°08.40'E, alt. 650 m. 10 Aug. 2010, Timdal 11757 (O L-163814, filed under *Lecidea degeliana*); Vågå, c. 300 m NE of the farm Viste, 61,86671°N, 9,02391°E. 13 June 2008, Westberg 08-198, 08-203, 08-205 (S F268461, F268462, F268463).

***Calvitimela perlata* (Haugan & Timdal) R. Sant, 2004**

MycoBank: MB 478956

Calvitimela perlata (Haugan & Timdal) R. Sant. Lichen-forming and lichenicolous fungi of Fennoscandia: 73. 2004.

Basionym. *Tephromela perlata* Haugan & Timdal, Graphis Scripta 6(1): 22 (1994).

Holotype. NORWAY. Sør-Trøndelag: Oppdal municipality, Drivdalen, by the rapids in the lower part of the river Kaldvella, 62°17'N, 9°35'E, alt. 940–980 m, exposed rock face in the subalpine region. 23 July 1993, E. Timdal 7535 (O L-125!), TLC: rangiformic acid, norrangiformic acid, unknown substances.

Distribution. **New to Sweden.** The species was previously known only from Norway and Greenland (Haugan and Timdal 1994). It resembles the more common *C. aglaea* (Sommerf.) Hafellner, but differs in forming white areolae (Fig. 4), slightly longer ascospores



Figure 4. *Calvitimela perlata* (O L-195661). Scale: 5 mm.

(11.5–17 × 5–7.5 µm; Haugan and Timdal 1994), and in the presence of rangiformic and norrangiformic acids in the thallus. In *C. aglaea*, the areolae are usually pale yellow, the ascospores shorter (9–13.5 × 5–7.5 µm), and the thallus contains atranorin, bourgeanic acid, usnic acid (rarely lacking), and sometimes stictic acid (Haugan and Timdal 1994).

In Norway, the species grows on sun-exposed, more or less sloping rock surfaces, often where water is trickling or near rivers or waterfalls in the subalpine and alpine regions. The Swedish locality is a boulder in the alpine region.

Specimen examined. SWEDEN. Torne Lappmark: Låktatjåkka, 68°24.87'N, 18°19.07'E, alt. 640 m, steep face of boulder in the low alpine region. 8 July 2014, Timdal 13464-1 (O L-195661), TLC: rangiformic acid (major). norrangiformic acid (minor), unknown substances (minor).

***Cladonia albonigra* Brodo & Ahti, 1996**

MycoBank: MB 415621

Cladonia albonigra Brodo & Ahti. Canad. J. Bot. 74: 1152. 1996

Holotype. CANADA. British Columbia: Queen Charlotte Islands, Graham Island, 2 mi. SE of Port Clements. 1971, Brodo 18104 & Wong (CANL).

Distribution. Confirmed for Sweden. The species is reported from the province Torne Lappmark in northernmost Sweden by Ahti and Stenroos (2013), but no speci-



Figure 5. *Cladonia albonigra* (O L-195662). Scale: 5 mm.

men was cited and there are no specimens from Sweden in S or UPS. We here confirm its presence in Sweden and that province. The specimen (Fig. 5) was found on the same rock as *Calvitimela perlata* referred to above.

Specimen examined. SWEDEN, *Torne Lappmark*: Låktatjåkka, 68°24.87'N, 18°19.07'E, alt. 640 m, steep face of boulder in the low alpine region. 8 July 2014, Timdal 13464-2 (O L-195662), TLC: fumarprotocetraric acid (major).

Lecidea degeliana Hertel, 1970

MycoBank: MB 342410

Lecidea degeliana Hertel. Herzogia 2: 41. 1970.

Holotype. NORWAY, Troms: [Harstad, Hinnøy], Sandtorg Nordvik, *ad saxum mica-cei-schistosum aeneum fuscigrum tinctum*. 14 July 1953, G. Degelius (UPS L-108141!).

Distribution. New to Sweden. *Lecidea degeliana* was described by Hertel (1970) from material collected by Degelius in northern Norway. Degelius himself (1982) reported a second find from the island of Vega in northern Norway but no further localities was mentioned by Hertel (1995) and we have not found any other literature reports of this species although collections have slowly been accumulating in the herbarium in Oslo. During an excursion to Sør-Trøndelag in Norway 2012, Swedish lichenologists had the opportunity to study the species in the field, and it was thereafter discovered in

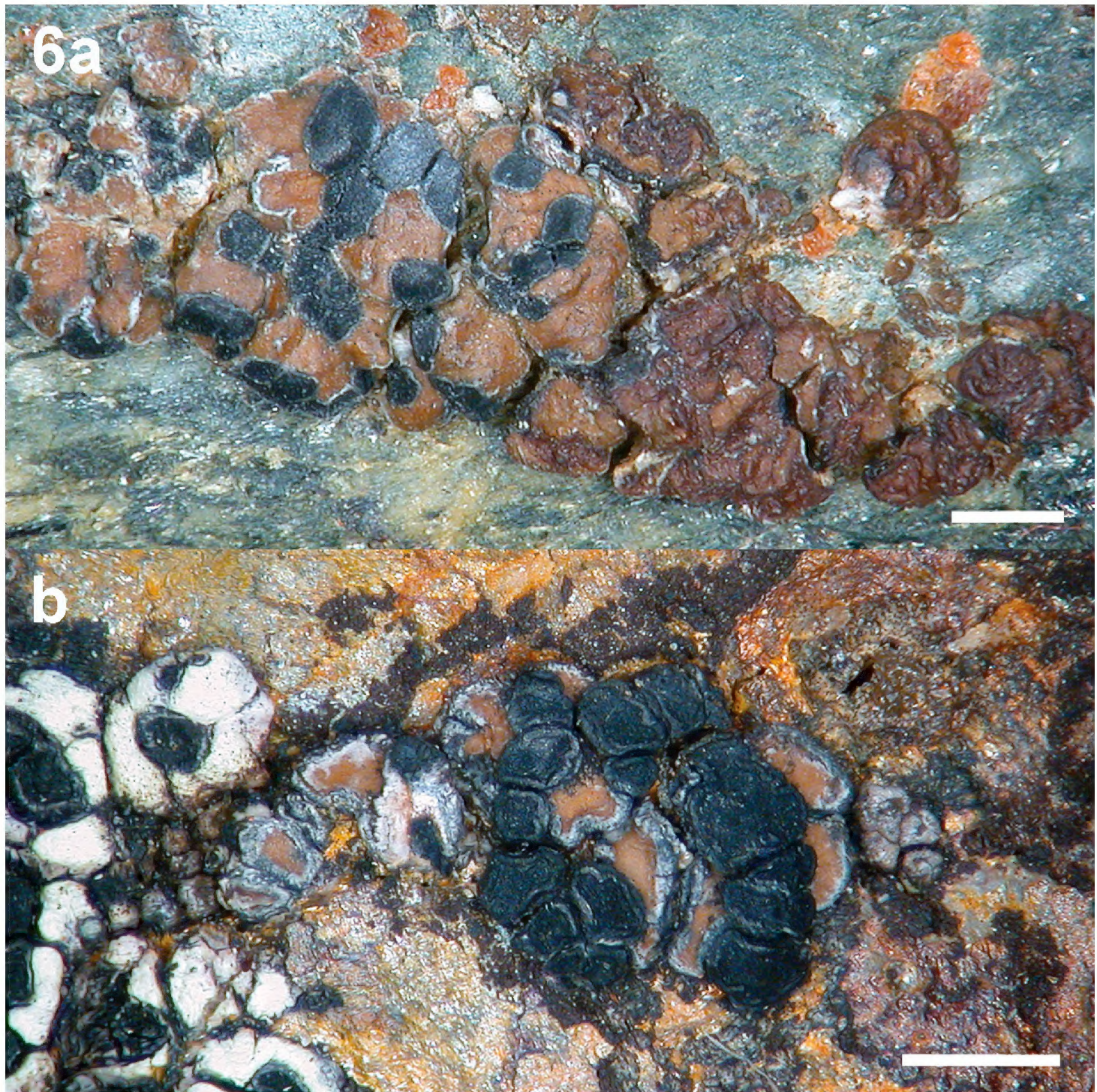


Figure 6. *Lecidea degeliana*. **a** With the host, *Acarospora* sp., still visible (S F265204) **b** Independent thallus (S F265201). Scale: 1 mm.

the Abisko area in northern Sweden in 2013 and on a second locality a few kilometers from the first in 2014. The species is so far only known from Scandinavia.

This small species may easily be overlooked or mistaken for a poorly developed *L. fuscoatra*. It is, however, a quite distinct species once discovered. The species is initially developing as a parasite on *Acarospora* spp. (Fig. 6). The thallus of *L. degeliana* is areolate, up to 3 mm wide, and frequently fertile with black, rounded or angular apothecia that are immersed in, or somewhat raised from the areoles; up to 0.2–0.6(–0.7) mm diam. In the microscope the apothecia have a greenish or bluish green hymenium, a black or greenish black epihymenium, and a dark brown hypothecium. The excipulum has a yellowish inner part, and the outer part is dark grey. The ascospores are ellipsoid–subglobose, $5.5\text{--}7 \times 4\text{--}5\ \mu\text{m}$ in the studied samples. The thallus contains the gyrophoric acid syndrome (Hertel 1995); thallus cortex in section K–, C+ red, excipulum in section K–, C– or C+ red.

Hertel (1968) described *Lecidea grummannii* from Kärnten, Austria, another species growing parasitically on small brown *Acarospora* sp. That species is as far as we know only known from the type. According to Hertel (1995), *L. grummannii* differs from *L. degeliana* in having broader spores (5.2–5.5 vs 3.5–5.5 μm in *L. degeliana*), a paler hypothecium, (pale brown vs dark to blackish brown); a blue-green epithecium (vs olive- or greyish green in *L. degeliana*) and a paler thallus (cream coloured–whitish to beige vs beige to pale brown). In our experience of *L. degeliana* these characters are not so clear-cut and only the dark brown hypothecium seem to be a consistently different character compared to the description of *L. grummannii*.

Lecidea degeliana has mostly been found on calcareous rocks in exposed, subalpine habitats but also on siliceous and iron-containing rocks. There seem to be several different species of *Acarospora* involved as hosts but they are often sterile and mostly unidentified by us. They all belong to the small brown species of *Acarospora* s. str., and are in one case identified as *A. versicolor* through sequencing of the ITS and in another case tentatively identified morphologically as *A. rugulosa*.

Specimens examined. NORWAY. Hedmark: Ringsaker, the islet Holmen S of Helgøya in lake Mjøsa, 60°43'N, 11°01'E, alt. 125–130 m. 11 Apr. 1982, Timdal 3230 (O L-37925), TLC: gyrophoric acid; Ringsaker, Helgøya, the islet Holmen in lake Mjøsa, 60°43'N, 11°01'E, alt. 125 m. 27 March 1994, Haugan 3699 (O L-37924); Nordland: Vega, Vega Is., Holand, Exposed blasted rock (clay schist) at the road near Kirköy. 4 July 1979, Degelius V-2406 (UPS L-143256); Oppland: Dovre, Verkensætri, rock outcrop by the houses, 62°03.8 'N, 9°32.7 'E, alt. 1010–1020 m. Calciferous schist. 3 July 1995, Haugan & Timdal 8035 (O L-15096); Dovre, Hjelle, 62°03.21'N, 9°08.40'E, alt. 650 m. 10 Aug. 2010, Timdal 11757 (O L-163814); Lom, Runningsgrenda, Klypa. Alt. 720–850 m. 61.7158°N, 8.2342°E. 28 June 2013, Westberg (S F265203), Lunner, Råsted, 60°18'N, 10°37'E, alt. 330 m. S-facing, steep rock face. 19 June 1983, Timdal 3844 (O L-37926), TLC: gyrophoric acid; Vågå, hill E of Svarthåmårbekken, 61°52.10'N, 8°59.21'E, alt. 690 m. 30 June 2013, Bendiksby, Haugan & Timdal 12978 (O L-184391); Westberg (S F265204). SWEDEN. Torne Lappmark: Jukkasjärvi par., Björkliden, N side of the river Rakkasjohka, just N of the trail from Björkliden Fjällby to Nuolja, alt. 495 m. 68.4053°N, 18.6698°E. 6 Aug. 2013, Westberg (S F265201); Björkliden, just W of the road E10 at its crossing over the river Rakkasjohka. 68.4029°N, 18.6944°E. 6 July 2014, Westberg VAR152 (S F265198).

***Nephroma helveticum* Ach, 1810**

MycoBank: MB 357157

Nephroma helveticum Ach. Lich. Univ.: 523. 1810.

Lectotype. 'In montibus Helvetiae, Schleicher' (H-ACH 1470B, James & White 1987).

Distribution. **New to Sweden.** *Nephroma helveticum* is a cosmopolitan species complex with a wide ecological amplitude and a large morphological and chemical



Figure 7. *Nephroma helveticum* (O L-196491) Scale: 5 mm.

variation. In Europe, however, the species is very rare and appears to have declined considerably (Klepsland 2103, James and White 1987). There are very few recent finds, among them a locality in Oppland in Norway, which is the first find in that country (Klepsland 2013). In the Nordic countries it is elsewhere known from a few old localities in Finland (Vitikainen 2007). Here we report it from one locality found in 2009 in Västerbotten and in addition we have found an old specimen in the herbarium in Stockholm from Västerbotten collected by Sten Ahlner in 1945 but never reported in the literature. The two localities are located 2.5 kilometers apart. We also report a second find of this species in Norway. The species is recognized by its tomentose lower surface without papillae (Fig. 7) and its chemistry of secondary metabolites, including the terpenoid T4 (James and White 1987). The most similar species *N. resupinatum* also has a tomentose lower surface but has white papillae between the tomentum and lacks secondary metabolites. One of the recently collected specimen from Västerbotten has been barcoded and the ITS sequence confirms the identity as *N. helveticum*.

On Ahlner's locality, Borstaberget, the bedrock consists of greenstone (porphyrite) and the mountain has long southwest facing slopes with steep cliffs. Ahlner collected, together with *N. helveticum*, also the rare lichen *Heterodermia speciosa*. On the mountain Mitti-Skansberget *N. helveticum* was found in 2009 in two places 200 meters apart. It was found growing on conglomerate cliffs in the southwest facing precipices. Other species that were found on the cliffs were *Peltigera rufescens*, *Lobaria scrobiculata*, *L. pulmonaria*, *Fuscopannaria leucophaea* and *Biatora vernalis*.

Specimens examined. NORWAY. Buskerud: Nes municipality, Gardnosberget, MGRS: 32V NN 0230, 2309, alt. 300 m, east-facing, steep slope below high mountain wall, open spruce forest over rock field, on boulder. 10 September 2013, Hofton 13176 (O L-196491), TLC: series of terpenoids, including T4 (major). SWEDEN. Västerbotten: Jörn par., Borstaberget. 24 June 1945, Ahlner (S L-54838); Norsjö par., Mitti-Skansberget SE precipice, SE of Klövertjärnen, 9.7 km NW of Petiknäs church. 28 Sept. 2009, Jonsson 4200 (UPS L-193714).

***Peltula placodizans* (Zahlbr.) Wetmore, 1970**

MycoBank: MB 343163

Peltula placodizans (Zahlbr.) Wetmore, Ann. Missouri Bot. Gard. 57: 179. 1970.

Basionym. *Heppia placodizans* Zahlbr., Bull. Torrey Bot. Club 35: 299 (1908).

Holotype. U.S.A. Arizona, Tucson, Tumamoc Hill. 1908, Blumer (W, holotype, not seen).

Distribution. New to the Nordic countries. The species is widely distributed in arid areas of both the Northern and Southern Hemispheres (Egea 1989). The nearest locality is found in Northern Italy (Vinschgau in South Tyrol; Buschardt 1979), and the species fits in the element of continental lichens with a widely disjunct distribution from the Alps to the upper valleys of southeast Norway. Other species with a similar disjunction include *Buellia elegans* Poelt, *Gyalolechia desertorum* (Tomin) Søchting et al., *Psora vallesiaca* (Schaerer) Timdal, *Toninia sculpturata* (H. Magn.) Timdal, *T. taurica* (Szatala) Oxner, *T. tristis* (Th. Fr.) Th. Fr., and *Xanthocarpia tominii* (Savicz) Frödén et al. The species is recognized by the crustose to subsquamulose, dark olivaceous brown thallus composed of areolae, which are up to 1 mm diam. and with marginal, black, granular soralia. The Norwegian material is sterile. The other *Peltula* species in the Nordic countries, *P. euploca* (Ach.) Poelt, differs in forming much larger, pel-tate squamules, up to 5 mm diam. The Norwegian specimen of *Peltula placodizans* is identified with some uncertainty, as the material for comparison (17 specimens from Europe, Africa, Australia, and North and South America, borrowed from GZU), was often more olivaceous brown than the dark brown Norwegian material (Fig. 8). Wetmore (1970) indicates that the species is probably a complex of several taxa.

In Norway, the species was found on a vertical wall of calcareous rock in a steep, west-facing hillside. The site has apparently previously been an open or sparsely wooded pasture, but is now in the process of being transformed into spruce forest. Other remarkable lichens collected at the site include *Metamelanea caesiella* (Th.Fr.) Henssen, *Physcia dimidiata* (Arnold) Nyl., *Thallinocarpon nigritellum* (Lettau) P.M.Jørg., and *Toninia alutacea* (Anzi) Jatta.

Specimen examined. NORWAY. Oppland: Sør-Fron municipality, Harpefoss, along the trail W of farm Tåkåstad towards Mt. Lundin, 61°34.95'N, 9°52.55'E, alt. 490 m. 1 Oct. 2007, Timdal 11054 (O L-158470), TLC: no lichen substances.



Figure 8. *Peltula placodizans* (O L-158470). Scale: 1 mm.

***Phacographa protoparmeliae* Hafellner, 2009**

MycoBank: MB 513175

Phacographa protoparmeliae Hafellner. Bibl. Lich. 100: 106. 2009.

Holotype. AUSTRIA, Kärnten: Hohe Tauern, Kreuzeck-Gruppe, Kalkschieferwände in den SE-Hängen der Sensenspitze N der Turgger Alm, c. 200 m. 17 July 1978, Hafellner 603 (GZU).

Distribution. New to the Nordic countries. *Phacographa* was described by Hafellner 2009 who included three species in the genus. It belongs in the newly described family Lecanographaceae within the Arthoniales (Frisch et al. 2014). *Phacographa protoparmeliae* (Fig. 9) was originally reported from Austria and Spain (Hafellner 2009), and a specimen was later discovered in the Murmansk region in arctic Russia (Fryday 2011). Here we report it for the first time from the Nordic countries from two localities in Norway. Both are at old copper mines in subalpine habitats in the mining district of Røros in central Norway.

Phacographa protoparmeliae (Fig. 9) is a lichenicolous fungus growing on the common and widespread saxicolous lichen *Protoparmelia badia*. The apothecia of *Phacographa* have a black margin around a dark brown disc; they are up to 1.2 mm wide in the Norwegian material and form clustered groups of 2–6 apothecia. Microscopically it is characterized by its 3-septate, spores, $22\text{--}25 \times 6\text{--}7\text{--}(8) \mu\text{m}$ that are



Figure 9. *Phacographa protoparmeliae* (S F265200). Scale: 1 mm.

colourless but have a perispore sheath that becomes brown with age. More detailed descriptions can be found in Hafellner (2009) and Fryday (2011).

Specimens examined. NORWAY. Sør-Trøndelag: Røros, Storwartz, at the site of the old copper-mine, 62°37.63'N, 11°31.19'E. 15 June 2012, Westberg 12-030 (S F265199); Røros, Klasberget, old copper mine NE of farm Svensvollen, 62°39.25'N, 11°34.06'E. 16 June 2012, Westberg 12-052 (S F265200).

***Rhizocarpon pycnocarpoides* Eitner, Jahresbericht der Schles, 1911**

MycoBank: MB 404075

Rhizocarpon pycnocarpoides Eitner, Jahresbericht der Schles. Gesellschaft für vaterl. Cultur 88, 2: 46. 1911.

Holotype. CZECH REPUBLIC, Krkonoše Mts, “an den alten Bergwerken im Riesengrunde” (not seen).

Distribution. New to the Nordic countries. The species is apparently previously known only from the type locality in the Krkonoše Mts, where it was collected by Eitner about 1910 and by Kuťák in 1927. We have not seen the type material, but rather one duplicate of the material distributed by Kuťák in his exsiccate (Flechtensamml. Böhmen No. 520, O-L-184255).



Figure 10. *Rhizocarpon pycnocarpoides* (O L-184267). Scale: 1 mm.

The species grows on rocks with a high content of iron and the thallus is rust coloured (Fig. 10). It resembles *R. oederi* (Weber) Körb., which may be found in the same localities, but differs primarily by forming larger ascospores (mainly muriform, $24\text{--}30 \times 10\text{--}15 \mu\text{m}$ in *R. pycnocarpoides* vs. mainly 3-septate, $12\text{--}18 \times 3\text{--}7 \mu\text{m}$ in *R. oederi*). Furthermore, the apothecia are more sessile, more regularly rounded, and with a thicker margin in *R. pycnocarpoides*, not in level with the areolae and angular to flexuose as in *R. oederi*. An unpublished phylogenetic analysis of the genus *Rhizocarpon* (Bendiksby et al. in prep.), which includes four Norwegian specimens of *R. pycnocarpoides*, places the two species in sister position and well separated in the ITS marker.

Rhizocarpon pycnocarpoides has been found at five localities in Norway and one in Sweden. All localities are rich in rust stained rock and most sites are in or near old copper or zinc mines.

Specimens examined. CZECH REPUBLIC. Krkonose. 1927, V. Kuťák, Kuťák, Flechtensamml. Böhmen No. 521 (O L-184255). NORWAY. Buskerud: Ringerike municipality, the old mine Ertlien, $60^{\circ}04.14'\text{N}$, $10^{\circ}02.89'\text{E}$, alt. 160 m. 18 May 2013, Rui & Timdal 12854 (O L-184267), TLC: No lichen substances; Nord-Trøndelag: Namsskogan municipality, S bank of river Namsen just W of Storholmen, $64^{\circ}55.60'\text{N}$, $13^{\circ}08.72'\text{E}$, alt. 200 m. 8 Aug. 2012, Haugan 11128 (O L-183810), TLC: no lichen substances; Nordland: Fauske municipality, Sulitjelma, Furuhaugen, site of old copper mine (in operation 1896–1921), $67^{\circ}09.02'\text{N}$, $15^{\circ}57.92'\text{E}$, alt. 260 m. 11 Aug. 2012, Haugan 11125 (O L-183808), TLC: no lichen substances; Oppland: Lunner municipality, the old zinc mine Nysetergru-

vene (in use 1889–1931), 60°15.69'N, 10°41.62'E, alt. 520 m. 16 July 2012, Rui & Timdal 12665 (O L-179903); Sør-Trøndelag: Røros municipality, by river Orva upstreams from the bridge at Litlstuvollen, 62°38.78'N, 11°21.22'E, alt. 700 m. 16 June 2012, Bendiksby et al. 12630 (O L-179554, L-179560), TLC: no lichen substances; Røros, Klasberget, old copper mine NE of the farm Svensvollen. 62°39.25'N, 11°34.06'E. 16 June 2012, Westberg 12-061 (S F265205), TLC: no lichen substances. SWEDEN. Torne lappmark: Karesuando par., Pältsan (Bealccan), N-facing slope of the middle peak (1444 m). Alt. 1240 m. 69,0106°N, 20,2366°E. 3 Aug. 2011, Westberg P122 (S F265206).

***Sarcogyne algoviae* H.Magn, 1935**

MycoBank: MB 411790

Sarcogyne algoviae H.Magn. Rabenh. Krypt.-Fl., Edn 2 (Leipzig) 9(5.1): 78. 1935.

Holotype. [GERMANY, Bayern] Obere Seealpe in der Allgäuer Alpen bei Oberstdorf, c. 5000'. 1860, H. Rehm (S L2741!).

Distribution. New to Sweden. This is a little known species rarely reported in the literature. *Sarcogyne algoviae* belongs to the morphological group in *Sarcogyne* with a strongly carbonized margin (Westberg et al. 2015). The apothecia vary considerably in size (0.3–1.8 mm) and has a raised, often glossy margin that is incised at short and fairly regular intervals (Fig. 11a, b) forming 5–15 segments. The disc is brown to dark reddish brown and often has one or two small carbonized accretions on the surface. Further characters include a euamyloid hymenium, 65–105 µm tall and narrow, 1–1.5 µm wide paraphyses, ellipsoid to narrowly ellipsoid spores, 2.5–4 × 1.5 µm and a colorless hypothecium (Fig. 11c). It can primarily be confused with *S. clavus* and *S. hypophaea* (syn. *S. privigna*, see Knudsen et al. 2013) but is apparently not closely related to either of these species (see phylogeny in Westberg et al. 2015). *Sarcogyne clavus* in its current sense (e.g. Magnusson 1935) always grows on siliceous rocks, has larger apothecia (up to 6 mm wide) with a margin that is irregularly cracked and crenulate and has a yellowish, to pale brownish hypothecium. *Sarcogyne hypophaea* grows on both siliceous and calcareous rocks and has generally smaller apothecia 0.3–0.7(1.3) mm, with a different appearance. The margin can be without or with rather indistinct incisions or with fewer (3–8) incisions at irregular intervals.

We have found *Sarcogyne algoviae* on several localities in Scandinavia, two in the continental parts of southern Norway and two in the Abisko area in northernmost Sweden. In addition we have found a few specimens from the Swedish mountains under the name *S. clavus* in the herbarium UPS. In all localities it grows on soft, calcareous schist in alpine–subalpine habitats. *Sarcogyne algoviae* is already included in the checklist for Fennoscandia, originally based on a specimen from Finnmark in northernmost Norway (Santesson et al. 2004). That specimen, however, has broadly ellipsoid spores and stout paraphyses, c. 2.5 µm wide, and belongs to *Polysporina urceolata* (specimen in

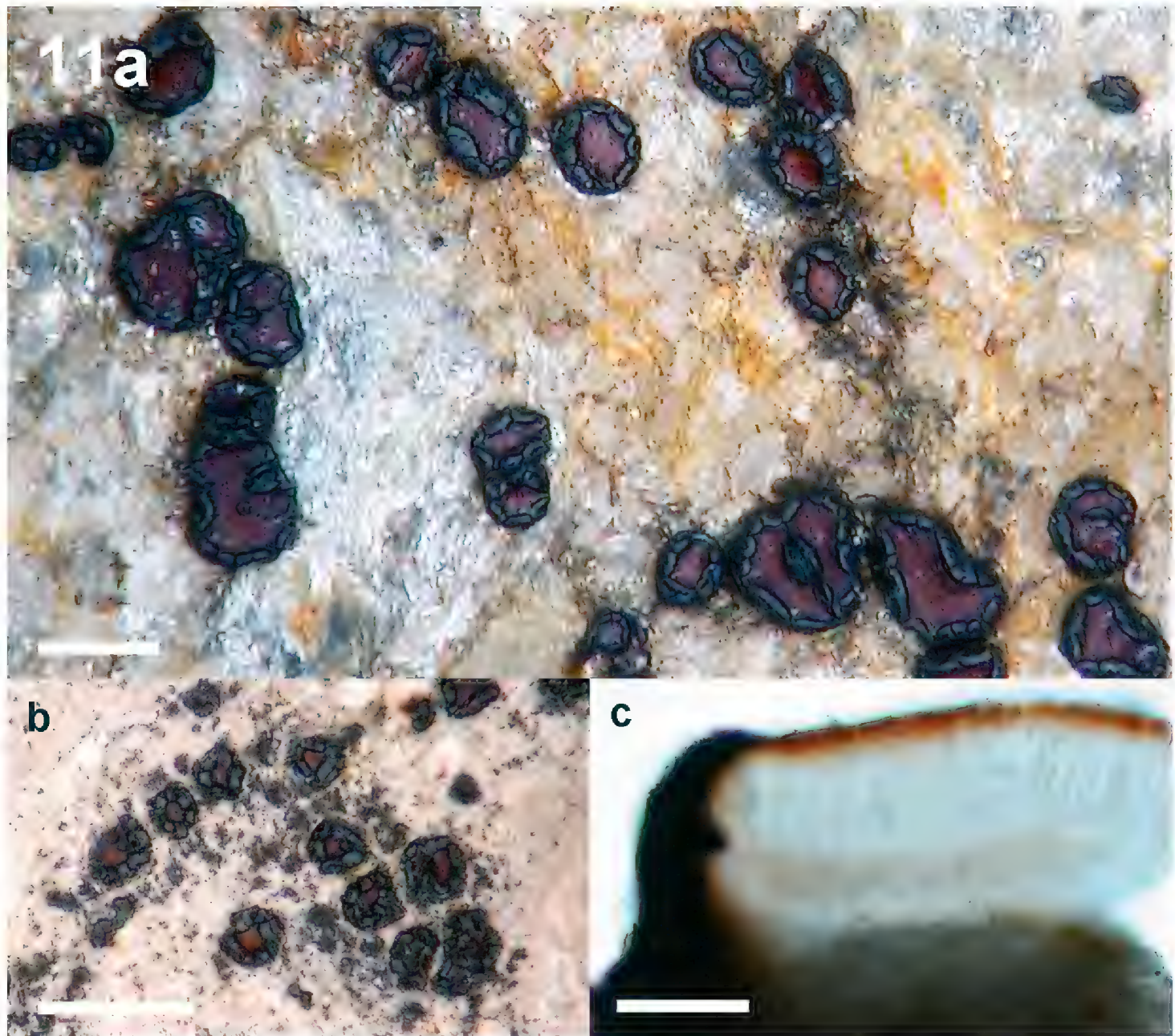


Figure 11. *Sarcogyne algoviae*. **a** Apothecia (S F122537) **b** Apothecia (S L2741, holotype) **c** Section of an apothecium showing a strongly carbonized margin and a colourless hypothecium (S F122537). Scale: 1 mm (**a–b**); 100 µm (**c**).

O, L-38325). Other literature or database records of *S. algoviae* from Norway must be considered unreliable but here we also confirm its presence in Norway.

Specimens examined. NORWAY. Oppland: Dovre, Jønndalen, Mt Nonshaugen, S precipice of the mountain, NE of farm Jønndalen, alt. 700–800 m. 12 June 2008, Westberg 08-276 (S F122564) Lom, Bøvertun, just W of the lake Bøvertunvatnet. Alt. 954 m. 12 June 2008, Westberg 08-165, 08-168, 08-169 (S F122535, F122537); Lom, Runningsgrenda, Klypa. Alt. 700–760 m. 61.7237°N, 8.0262°E. 28 June 2013, Westberg (S F265202); Nordland: Vega Island, farm Dalen. 22 June 1974, Degelius V-683 (UPS L-516318); Troms: Insula Rollöen. [undated], Norman (UPS L-680378). SWEDEN. Härjedalen: Tännäs par., Mt Stora Mittåklappen, the southern slope. 15 Aug. 1962, Santesson 14987b (UPS L-516445); Jämtland: Åre par., Storlien. 24 July 1950, Magnusson 22128a (UPS L-515993); Lule lappmark: Gällivare par., Vastenjau-re. 4 Aug. 1965, Gilenstam 1186a (UPS L-103743); Torne lappmark: Jukkasjärvi par., Björkliden, N side of the river Rakkasjohka, just N of the trail from Björkliden Fjällby to Nuolja, alt. 495 m. 68.4053°N, 18.6698°E. 6 Aug. 2013, Westberg (S F265208);

Latnjajaure field station, by the lake Latnjajaure c. 15 km W of Abisko. 68°20'N, 18°30'E, alt. 980–1000 m. 3 Aug. 1998, Westberg 2572 (LD).

***Sarcogyne hypophaeoides* Vain. ex H.Magn, 1935**

MycoBank: MB 411805

Sarcogyne hypophaeoides Vain. ex H.Magn. Rabenh. Krypt.-Fl., Edn 2 (Leipzig) 9(5.1): 84. 1935.

Lectotype. FINLAND. Tavastia australis, Luhanka, Keihäsniemi. 1873 (TUR-Vainio 25683, designated here, TUR-Vainio 25682 isotype!).

Distribution. New to Norway, Sweden and Austria. *Sarcogyne hypophaeoides* has until now been known from the type material in central Finland and from one collection in Germany (Magnusson 1935). It is a characteristic but overlooked lichen that appears to be widespread in Scandinavia. The apothecia are 0.5–1.2 mm wide, with a reddish brown to almost black disc sometimes with a central carbonized accretion. The margin is typically finely striated (Fig. 12a, b) and is softer and more leather-like in texture and not as strongly carbonized and brittle as the margin in e.g., *S. clavus*. The degree of carbonization varies however and in sections the central parts of the exciple may be rather weakly coloured (Fig. 12c). The hymenium is 70–90 µm tall and has a euamyloid reaction (I+ blue) and the spores are narrow and almost bacilliform, 3.5–5.5 × 1.0 µm. *Sarcogyne hypophaeoides* can mainly be confused with *S. clavus* or *S. hypophaea* but has a dark, brownish black to black hypothecium (Fig. 12c), which is a characteristic and diagnostic feature of this species. *Sarcogyne clavus* has a very uneven, cracked, crenulate margin and a yellowish to pale brown hypothecium. *Sarcogyne hypophaea* on the other hand, has a smooth margin, which usually appears segmented due to 2–3 deep incisions in the margin and a colorless hypothecium.

Sarcogyne hypophaeoides grows exclusively on siliceous rocks. We have found it on exposed, horizontal or sloping seashore rocks on the west coasts of Sweden and Norway, on lakeshores and on semi-exposed, vertical rocks or boulders in open coniferous forests. It is often growing with scattered apothecia on smooth rock surfaces or along cracks in the rock in a similar way to *S. clavus* and the two species have been found growing together on at least two localities. Difficulties to collect it and a superficial similarity to *S. clavus* are possibly reasons why this species has been overlooked. It appears to be fairly common in humid habitats in the boreal region of Fennoscandia but its distribution is incompletely known.

Specimens examined. AUSTRIA. Steiermark: Steirisches Randgebirge, Fischbacher Alpen, im Feistritzal, ca 2 km E von Rettenegg. 14 Nov. 1998, Kocourkova & Hafellner 46366 (GZU); NORWAY. Rogaland: Rennesøy, Fjøløy, ca 200 m. NE of the lighthouse. 11 June 2008, Westberg 08-139 (S F123697). SWEDEN. Bohuslän: Ljung par., Skarsjön. 31 Aug. 1916, Magnusson 17466 (UPS L-175686); Naverstad par., Tyftefjäll. 22 July 1917, Magnusson (UPS L-516234); Brastad par., Stora Bornö,

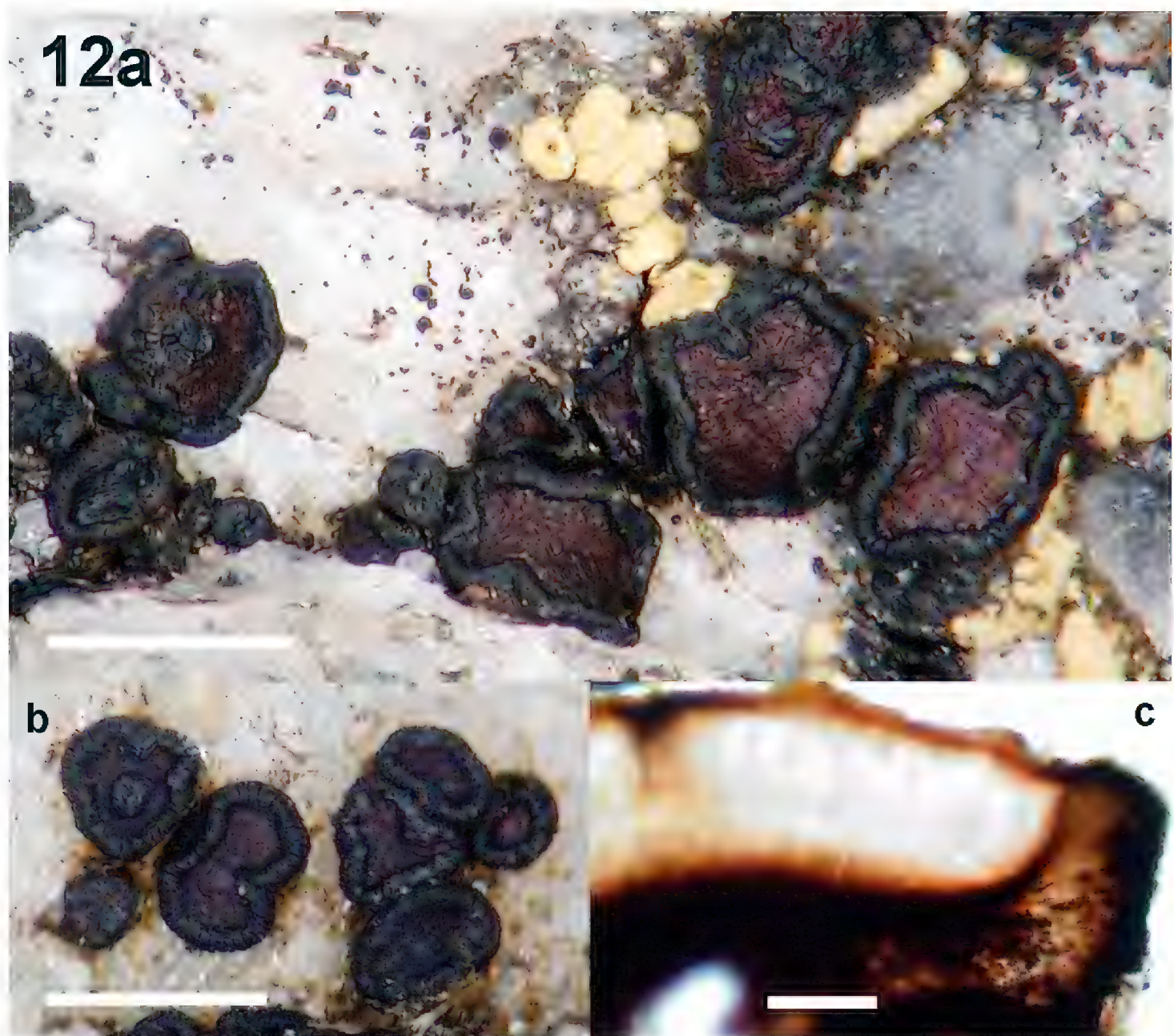


Figure 12. *Sarcogyne hypophaeoides*. **a** Apothecia (S F123697) **b** Apothecia (Kocourkova & Hafellner 46366 (GZU)) **c** Section of an apothecium showing a carbonized margin and a brownish black hypothecium (S F265197). Scale: 1 mm (**a–b**); 100 μ m (**c**).

just S of Källviken on the E side of the island, c. 750 m SE of the research station. 58.3750°N, 11.5902°E. 4 Oct. 2013, Westberg (S F265197); Dalarna: Leksand par., Draggberget. Hermansson 14488 (UPS L-564677); Dalsland: Skållerud par., c. 5.5 km N of Skållerud church, SW slope of Skalåsen. 58.8268°N, 12.4435°E. 5 June 2008, Westberg 08-078 (S F120302); Gästrikland: Hille par., Iggön. 13 Aug. 1946, Ahlner (S F90566); Lycksele lappmark: Tärna par., Ume älv, Över-Umans sydvästligaste vik. 18 Aug. 1960, Du Rietz 927 (UPS L-115656); Pite lappmark: Arvidsjaur par., Pite älv, Trollforsen, nedre delen, N-sidan uppströms bron. 24 Aug. 1962, Du Rietz 486b (UPS L-113499); Uppland: Djurö par., Runmarö, S of Kasviken, along a forest-trail. 59,2612°N, 18,7666°E. 11 May 2009, Westberg, Millanes & Wedin 09-308 (S F265196), Värmland: Gustav Adolf par., NW of Uddeholmshyttan. 2 Sept. 1981, Sundell 14905a (UPS L-516265); Västmanland: Grythyttan par., c. 1400 m S of Loka Brunn, at the south tip of the lake S. Loken. 59.5926°N, 14.4844°E. 1 May 2008, Westberg 08-002 (S F119718).

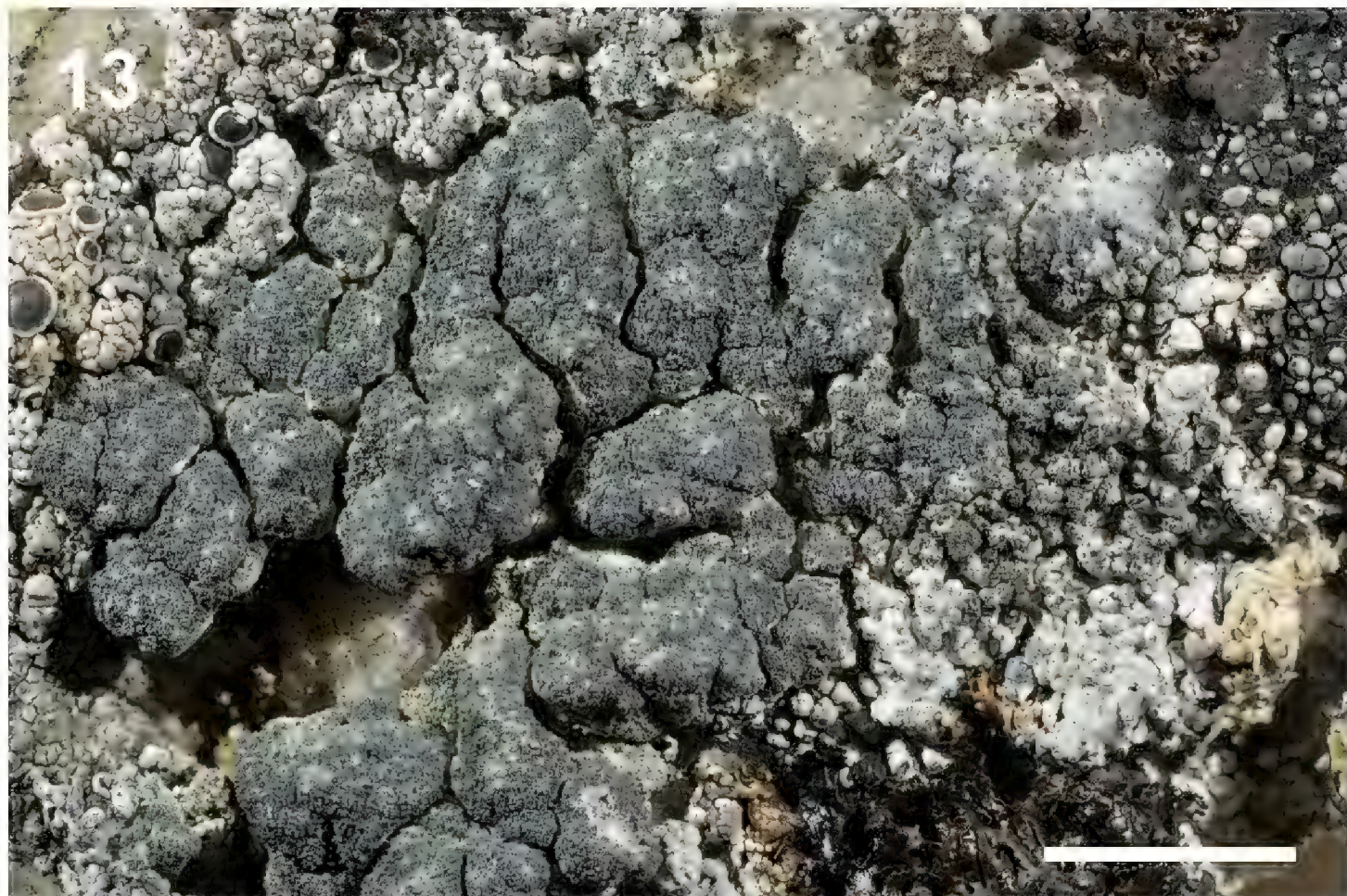


Figure 13. *Tephromela grumosa* (O L-190787). Scale: 5 mm.

***Tephromela grumosa* (Pers.) Hafellner & Cl. Roux, 1985**

MycoBank: MB 103854

Tephromela grumosa (Pers.) Hafellner & Cl. Roux. Bulletin de la Société Botanique du Centre-Ouest 7: 829. 1985.

Basionym. *Lichen grumosus* Pers., Ann. Bot. Usteri 14: 36. 1795. Nom. nov. *Lichen caerulescens* Pers., Ann. Bot. Usteri 11: 15. 1794. Nom. illeg. (non *Lichen caerulescens* Hagen 1782).

Type. Sine loc., „ad saxa arenaria (rubicunda), a Dom. Heyder primo observatus“ (Not seen).

Distribution. New to Norway. *Tephromela grumosa* has been expected to occur in Norway, as it is known from a number of provinces in Sweden and Finland. It occurs in West, Central, and North Europe and in Asia (Lambley and Purvis 2009). The species is rather closely related to the type species of the genus, *T. atra* (Huds.) Hafellner & Kalb, but it is always sorediate and rarely fertile (Fig. 13). In contrast to the genetically very heterogeneous *T. atra* s. lat., *T. grumosa* seem to be genetically rather consistent compared to its morphology (Muggia et al. 2008, 2014). The species is furthermore separated by their chemistries, i.e., by the presence of lichesterinic acid in *T. grumosa*. The chemistry of the Norwegian specimen was confirmed by TLC. According to Muggia et al (2008) *T. grumosa* is a cooltemperate species found on steeply inclined, acidic siliceous rocks. In the locality in Norway, luxuriant, partly fertile specimens grew on

steep faces of a large boulder in a stabilized S-facing talus. The rock is schistose, and probably somewhat calciferous. The locality is situated in one of the driest areas in Scandinavia, with an annual precipitation of c. 350 mm. In other habitats, e.g. on hard, granitic rocks in coastal heath on the Swedish west coast, specimens of this species are much thinner and less prominent.

Specimens examined. NORWAY. Oppland: Lom municipality, Runningsgrenda, Klypa. 61°43.41'N, 8°15.67'E, alt. 730 m. 28 June 2013, Bendiksby et al. 12357 (O L-190787); TLC: atranorin, lichesterinic acid. SWEDEN. Bohuslän: Sotenäs municipality, Ramsviklandet nature reserve, W of Haby. 58°24.50'N, 11°14.55'E, alt. 20 m. 25 Mar. 2012, Haugan 11501 (O L-184061).

***Tremella lobariacearum* Diederich & M. S. Christ, 1996**

MycoBank: MB 415289

Tremella lobariacearum Diederich & M. S. Christ. Bibl. Lichenol. 61: 103. 1996.

Type. PORTUGAL. *Madeira*: Rabaçal, on *Lobaria pulmonaria*. 8 Apr. 1992, P. Diederich 4935 (LG – holotype; herb. Diederich – isotype; S F102418 - isotype!).

Distribution. New to the Nordic countries. *Tremella lobariacearum* was described by Diederich (1996) and is currently known from Africa (Ile de la Réunion), Asia (Japan, Philippines, and Russia), Europe (British Isles, France, and Portugal), Macaronesia (Canary Islands and Madeira), Oceania (Papua New Guinea) and South America (Bolivia, Colombia, Ecuador, and Peru), growing on *Lobaria* and *Pseudocyphellaria* species (Diederich 1996, 2003, van den Boom and Etayo 2000, Etayo 2002, 2010, Coppins et al. 2012, Flakus and Kukwa 2012). The species induces the formation of pale-brown to dark-brown galls on the isidia or soredia of the host (Fig. 14), or occasionally also directly on the thallus. The basidia are 2-celled. Two asexual morphs, consisting of lunate conidia and asteroconidia, are often found within the galls. *Tremella lobariacearum* is here reported from Norway and from the Nordic Countries for the first time, growing on *Lobaria pulmonaria*. The species is associated to habitats with high humidity and oceanic influence. The only specimen reported was collected, together with other non-infected *L. pulmonaria* thalli in an area with mixed and rich populations of *Lobaria*, in a *Fraxinus*-dominated open broad-leaved deciduous stand.

Tremella includes mainly mycoparasitic taxa that grow on a wide range of fungal hosts, including lichenized hosts. However, mycologists and lichenologists in general did not look much at the lichenicolous species until the first comprehensive study by Diederich (1996). Since then, several new species have been described (Diederich 2003, Sérusiaux et al. 2003, Diederich 2007, Zamora et al. 2011, Diederich et al. 2014, Millanes et al. 2012, 2014), and an increased interest has resulted in numerous new records, especially in the Nordic countries (Holien and Tønsberg 1994, Alstrup et al. 2004, 2008, Pippola and Kotiranta 2008, Westberg et al. 2008, Svensson and Westberg 2010, Knutsson and Johansson 2011, Millanes et al. 2014, Thell et al. 2014,



Figure 14. *Tremella lobariacearum*. Galls induced by *Tremella lobariacearum* on *Lobaria pulmonaria* (S F263902). Scale: 1 mm.

Westberg and Thor 2014). Nevertheless, both the actual diversity and the distribution area of most species are still largely unknown.

Specimen examined. NORWAY. Hordaland: Tysnes municipality, Støle, 59°59.14'N, 05°29.84'E, alt. 60 m. 6 Apr. 2008, Asplund & Larsson (S F263902).

***Tremella wirthii* Diederich, 1996**

MycoBank: MB 415310

Tremella wirthii Diederich. Bibl. Lichenol. 61: 164. 1996.

Holotype. GERMANY. Bayern: Neu-Ulm, Holzheim, Obstgarten WSW Steinheim, MTB 7626/2. 6 Feb 1991, V. Wirth 21713 (STU)

Distribution. New to the Nordic countries. *Tremella wirthii* was described by Diederich (1996) based on material from four localities in Germany, growing on an unidentified sterile corticolous lichen. The host was later described as *Protoparmelia hypotremella* (Aptroot et al. 1997), a species similar to *P. oleagina*, from which it differs by its paler colour and its isidia-like granules. Both species are among the few corticolous *Protoparmelia* species, and grow on old wooden fences and buildings, and on deciduous and coniferous trees (Aptroot et al. 1997, 2001, 2004, Clerc 2004, Diederich and Sérusiaux 2000,

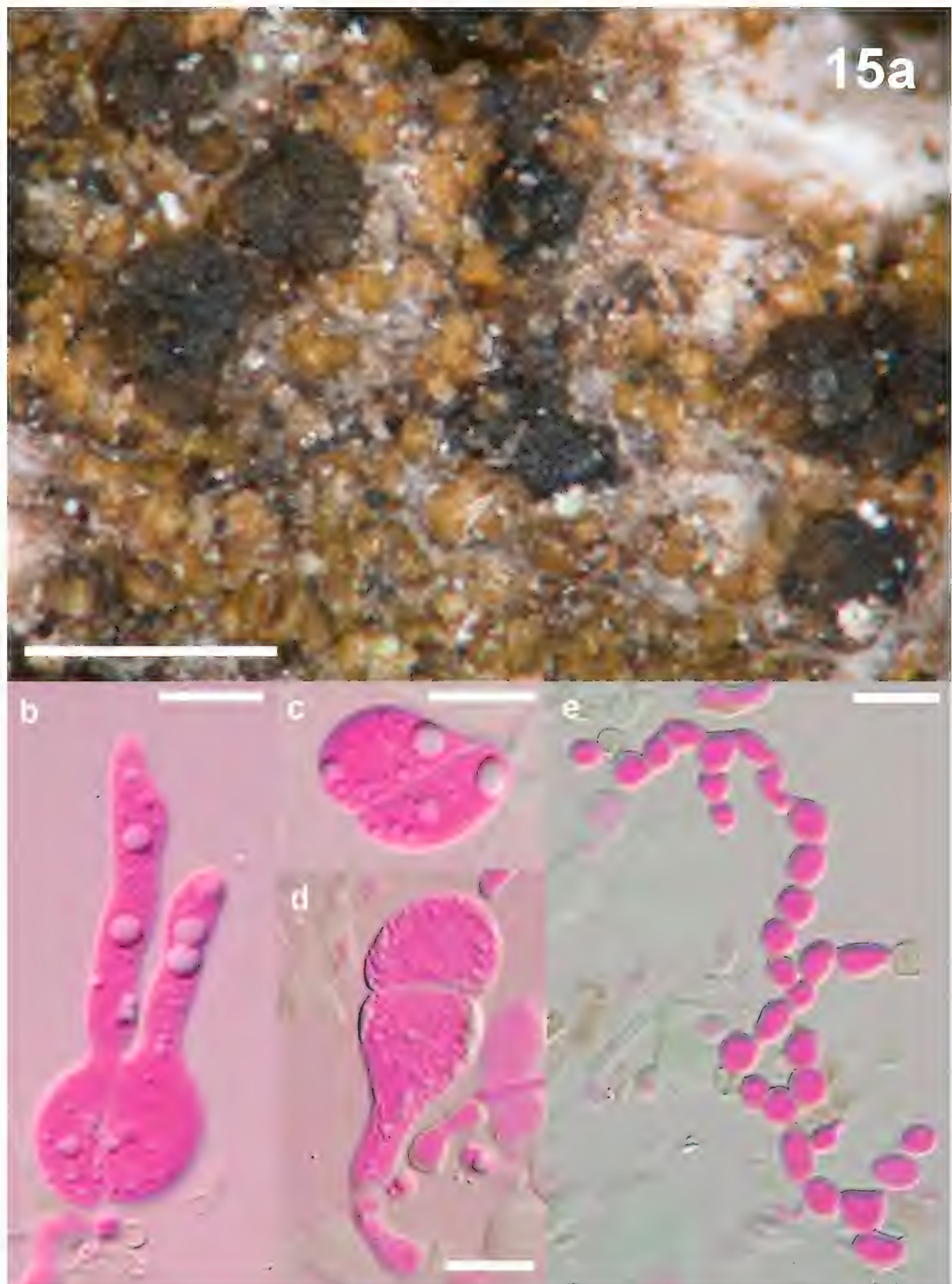


Figure 15. *Tremella wirthii*. **a** Basidiomata on the thallus of *Protoparmelia oleagina* (S F262967) **b** Basidium with one longitudinal septum (S F262963) **c** Basidium with one oblique septum (S F262963) **d** Basidium with one tranverse septum (S F262963) **e** Catenulate conidia (S F262963). Scale: 0.5 mm (**a**); 10 mm (**b–e**).

Scholz 2000, Hafellner and Türk 2001, Palice et al. 2006, van den Boom et al. 2007, Kubiak et al. 2010, Kukwa et al. 2012, Himelbrant et al. 2014). Aptroot et al. (1997) reported the presence of *Tremella wirthii* on specimens of *P. hypotremella* from Austria and the Netherlands. In the type locality of *Protoparmelia hypotremella*, in the Netherlands, *T. wirthii* was found both on *P. hypotremella* and *P. oleagina*. The three Scandinavian specimens grow on *Protoparmelia oleagina*. They were collected on wood of an old hay drying rack in the agricultural landscape of the Siljan Ring, an area with a calcareous bedrock, and the only locality in Sweden where *P. hypotremella* has been reported. Here, however, *Tremella wirthii* has not yet been found on that host. In the Nordic countries *Protoparmelia oleagina* occurs in Norway and Sweden (Nordin et al 2015). *Tremella wirthii* forms dark basidiomata, which are rarely bigger than 0.5 mm in diam., on the host thalli (Fig. 15a). Some micromorphological differences have been found between Swedish and Central European material. The specimens studied in the original description had 2–4 celled, longitudinally septate basidia, and no asexual morph was reported (Diederich 1996). The three specimens collected in Dalarna show typical basidia with 2 or 4 cells and longitudinal septa (Fig. 15b), but also basidia with oblique (Fig. 15c) or transverse (Fig. 15d) septa are present within the same basidioma. Moreover, in some cases there is an anamorph consisting of catenulate conidia (individual conidia $3\text{--}6 \times 3\text{--}6 \mu\text{m}$; Fig. 15e). Despite these differences, we consider the material from Sweden and Central Europe to be conspecific. The basidium morphology is extremely variable in many species of *Tremella* (Zamora et al. 2011, Millanes et al. 2012), and, when present, the occurrence of conidia is not constant in all specimens of the same species. Since the original description was based on four specimens only, the morphological variation within the taxon may well be greater than originally observed. *Tremella wirthii* is probably overlooked in Sweden, and additional field and herbarium surveys could reveal its presence in places where *Protoparmelia oleagina* is abundant.

Specimens examined. SWEDEN. Dalarna: Orsa municipality 61°11.25'N, 14°52.43'E, alt. 255 m. 1 Oct. 2014, Jonsson FU5955 (S F262967); Dalarna: Orsa municipality 61°11.32'N, 14°52.45'E, alt. 253 m. 1 Oct. 2014, Jonsson FU5956 (S F262963); Mora municipality 60°55.67'N, 14°37.08'E, alt. 204 m. 2 Oct. 2014, Jonsson FU5957 (S F262952).

Acknowledgements

M. Westberg, A. Millanes and M. Wedin are supported by grants from The Swedish Taxonomy Initiative (Svenska Artprojektet) administered by the Swedish Species Information Centre (ArtDatabanken). M. Bendiksby, R. Haugan and E. Timdal were supported by The Norwegian Taxonomy Initiative (Norske Artsprosjektet; proj no: 70184216) administered by the Norwegian Biodiversity Information Centre (ArtsDatabanken). DNA barcoding of *R. pycnocarpoides* and *T. grumosa* was funded by the Norwegian Barcode of Life project (<http://www.norbol.org/>). We are grateful to the curators of the herbaria mentioned for loan of material. We thank our reviewers, in particular Paul Diederich, for valuable comments that improved the manuscript.

References

- Ahti T, Stenroos S (2013) *Cladonia*. In: Ahti T, Stenroos S, Moberg R (Eds) *Nordic Lichen Flora* 5, 8–87.
- Alstrup V, Christensen SN, Skytte Christiansen M, Jacobsen P, Poulsen R, Søchting U, Svane S (1990) Notes on the lichen flora of Denmark IV. *Graphis Scripta* 3: 1–11.
- Alstrup V, Grube M, Motiejūnaitė J, Nordin A, Zhurbenko M (2008) Lichenicolous fungi from the Skibotn area, Troms, Norway. *Graphis Scripta* 20: 1–8.
- Alstrup V, Svane S, Søchting U (2004) Additions to the lichen flora of Denmark VI. *Graphis Scripta* 15: 45–50.
- Aptroot A, Diederich P, van Herk CM, Spiers L, Wirth V (1997) *Protoparmelia hypotremella*, a new sterile corticolous species from Europe, and its lichenicolous fungi. *Lichenologist* 5: 415–424. doi: 10.1017/S0024282997000509
- Aptroot A, Sparrius L, van Herk K, de Bruyn U (2001) Origin and distribution of recently described lichens from the Netherlands. *Aktuelle Lichenologische Mitteilungen* 5: 13–25.
- Aptroot A, van Herk CM, Sparrius LB, Spier JL (2004) Checklist van de Nederlandse korstmossen en korst-mosparasieten. *Buxbaumiella* 69: 17–55.
- Buschardt A (1979) Zur Flechtenflora der inneralpinen Trockentäler unter besonderer Berücksichtigung des Vinschgaus. *Bibliotheca Lichenologica* 10: 1–419.
- Clerc P (2004) Les champignons lichénisés de Suisse. Catalogue bibliographique complété par des données sur la distribution et l'écologie des espèces. *Cryptogamica Helvetica* 19: 1–320.
- Coppins BJ, Seaward MRD, Simkin J (2012) British Isles list of lichens and lichenicolous fungi. September 2012 update to list. *British Lichen Society Bulletin* 111: 67–69.
- Culberson CF (1972) Improved conditions and new data for the identification of lichen products by a standardized thin-layer chromatographic method. *Journal of Chromatography* 72: 113–125. doi: 10.1016/0021-9673(72)80013-X
- Culberson CF, Johnson A (1982) Substitution of methyl *tert.*-butyl ether for diethyl ether in the standardized thin-layer chromatographic method for lichen products. *Journal of Chromatography* 238: 483–487. doi: 10.1016/S0021-9673(00)81336-9
- Degelius G (1982) The lichen flora of the island of Vega in Nordland, northern Norway. *Acta Regiae Societatis Scientiarum et Litterarum Gothobergensis, Botanica* 2: 1–127.
- Diederich P (1996) The lichenicolous heterobasidiomycetes. *Bibliotheca Lichenologica* 61: 1–198.
- Diederich P (2003) New species and new records of American lichenicolous fungi. *Herzogia* 16: 41–90.
- Diederich P (2007) New or interesting lichenicolous heterobasidiomycetes. *Opuscula Philolichenum* 4: 11–22.
- Diederich P, Sérusiaux E (2000) The lichens and lichenicolous fungi of Belgium and Luxembourg. An annotated checklist. Musée national d'histoire naturelle, Luxembourg, 207 pp.
- Diederich P, Millanes AM, Wedin M (2014) *Tremella umbilicariae* (Tremellomycetes, Basidiomycota), a new lichenicolous species on *Umbilicaria* from Peru. *Bulletin de la Société des naturalistes luxembourgeois* 115: 167–172.

- Egea JM (1989) Los generos *Heppia* y *Peltula* (Liquenes) en Europa Occidental y Norte de Africa. *Bibliotheca Lichenologica* 31: 1–122.
- Etayo J (2002) Aportación al conocimiento de los hongos liquenícolas de Colombia. *Bibliotheca Lichenologica* 84: 1–154.
- Etayo J (2010) Hongos liquenícolas de Perú. Homenaje a Rolf Santesson. *Bulletin de la Société Linnéenne de Provence* 61: 83–128.
- Flakus A, Kukwa M (2012) New records of lichenicolous fungi from Bolivia. *Opuscula Philolichenum* 11: 36–48.
- Frisch A, Thor G, Ertz D, Grube M (2014) The Arthonialean challenge: Restructuring Arthoniaceae. *Taxon* 63: 727–744. doi: 10.12705/634.20
- Fryday A (2011) *Phacographa protoparmeliae* new to northern Europe from arctic Russia. *Graphis Scripta* 23: 21–23.
- Frödén P (2010) Liten getlav *Flavoparmelia* soledians ny för Norden. *Lavbulletinen* 2010(3): 163–165.
- Hafellner J (2009) *Phacothecium* resurrected and the new genus *Phacographa* (Arthoniales) proposed. *Bibliotheca Lichenologica* 100: 85–121.
- Hafellner J, Türk R (2001) Die lichenisierten Pilze Österreich – eine Checkliste der bisher nachgewiesenen Arten mit Verbreitungsangaben. *Stapfia* 76: 3–167.
- Haugan R, Timdal E (1994) *Tephromela perlata* and *T. talayana*, with notes on the *T. aglaea*-complex. *Graphis Scripta* 6: 17–26.
- Hertel H (1968) Beiträge zur Kenntnis der Flechtenfamilie Lecideaceae I. *Herzogia* 1: 25–39.
- Hertel H (1970) Beiträge zur Kenntnis der Flechtenfamilie Lecideaceae III. *Herzogia* 2: 37–62.
- Hertel H (1995) Schlüssel für die Arten der Flechtenfamilie Lecideaceae in Europa. *Bibliotheca Lichenologica* 58: 137–180.
- Himelbrant DE, Motiejūnaitė J, Stepanchikova IS, Tagirdzhanova GM (2014) New records of lichens and allied fungi from the Leningrad Region, Russia. V. *Folia Cryptogamica Estonica* 51: 49–55. doi: 10.12697/fce.2014.51.04
- Holien H, Tønsberg T (1994) The 10th meeting of the Nordic Lichen Society in Nord-Trøndelag, Norway, 1993. *Graphis Scripta* 6: 67–75.
- Hultengren S, Malmqvist A, Arvidsson L (2011) Mörk örlav och praktsköldlav - två för Sverige nya oceaniska bladlavar. [*Hypotrachyna afrorevoluta* and *Parmotrema chinense* – two oceanic, foliose lichens new to Sweden]. *Svensk Botanisk Tidskrift* 105: 4–8.
- Ihlen PG, Wedin M (2008) An annotated key to the lichenicolous *Ascomycota* (including mitosporic morphs) of Sweden. *Nova Hedwigia* 86: 275–365. doi: 10.1127/0029-5035/2008/0086-0275
- James PW, White FJ (1987) Studies on the genus *Nephroma* I. The European and Macaronesian species. *Lichenologist* 19: 215–268. doi: 10.1017/S0024282987000239
- Lamley PW, Purvis OW (2009) *Tephromela* M. Choisy (1929). In: Smith CW et al. (Eds) *The lichens of Great Britain and Ireland*. British Lichen Society, London, 875–877.
- Klepsland J (2013) *Nephroma helveticum* and *N. tangeriense* new to Norway. *Graphis Scripta* 25: 33–38.
- Klepsland JT, Timdal E (2010) *Usnocetraria oakesiana* (Parmeliaceae) new to northern Europe. *Graphis Scripta* 22: 14–17.

- Knudsen K, Kocourková J (2010) Lichenological notes 1: Acarosporaceae. Mycotaxon 112: 361–366. doi: 10.5248/112.361
- Knudsen K, Kocourková J, Nordin A, Sipman H (in press) *Acarospora cinerascens* (Acarosporaceae), a poorly known species from the southern Alps (Italia and Switzerland). Herzogia.
- Knudsen K, Kocourková J, Westberg M (2013) The identity of *Sarcogyne hypophaea* (Nyl.) Arnold. Opuscula Philolichenum 12: 23–26.
- Knutsson T, Johansson T (2011) Lavfloran i Ottenbylund. Länsstyrelsen, Kalmar. Meddelandeserien 2011: 13.
- Kubiak D, Zaniewski P, Wrzosek M (2010) Notes on the distribution of *Sphinctrina anglica* and its host in Poland. Polish Botanical Journal 55: 239–242.
- Kukwa M, Łubek A, Szymczyk R, Zalewska A (2012) Seven lichen species new to Poland. Mycotaxon 120: 105–118. doi: 10.5248/120.105
- Magnusson AH (1924) New species of the genus *Acarospora*. Svensk Botanisk Tidskrift 18: 329–342.
- Magnusson AH (1926) New or misunderstood European lichens. Acta Horti Gothoburgensis 2: 71–82.
- Magnusson AH (1935) Acarosporaceae, Thelocarpaceae. In: Rabenhorst GL (Ed.) Kryptogamen-Flora von Deutschland, Österreich, und der Schweiz. 2nd IX. Die Flechten. Abt. 5(1). Borntraeger, Leipzig, 1–318.
- Menlove JE (1974) Thin-layer chromatography for the identification of lichen substances. Bulletin of the British Lichen Society 34:3–5.
- Millanes AM, Westberg M, Wedin M, Diederich P (2012) *Tremella diploschistina* (Tremellomycetes, Basidiomycota, Fungi), a new lichenicolous species growing on *Diploschistes*. Lichenologist 44: 321–332. doi: 10.1017/S0024282911000788
- Millanes AM, Diederich P, Westberg M, Knutsson T, Wedin M (2014) *Tremella rhizocarpicola* sp. nov. and other interesting lichenicolous Tremellales and Filobasidiales in the Nordic countries. MycoKeys 8: 31–41. doi: 10.3897/mycokeys.8.8176
- Nordin A, Moberg R, Tønsberg T, Vitikainen O, Dalsätt Å, Myrdal M, Snitting D, Ekman S [date of consultation 2015-09-08]. Santesson's checklist of Fennoscandian lichen-forming and lichenicolous fungi. Museum of Evolution, Uppsala University. <http://130.238.83.220/santesson/home.php>
- Palice Z, Guttová A, Halda JP (2006) Lichens new for Slovakia collected in the National Park Muránska planina (W Carpathians). In: Lackovičová A, Guttová A, Lisická E, Lizon P (Eds) Central European lichens – diversity and threat. Mycotaxon Ltd., Ithaca, 179–192.
- Pippola E, Kotiranta H (2008) The genus *Tremella* (Basidiomycota, Tremellales) in Finland. Annales Botanici Fennici 45: 401–434. doi: 10.5735/085.045.0601
- Sérusiaux E, Diederich P, Ertz D, van den Boom P (2003) New or interesting lichens and lichenicolous fungi from Belgium, Luxembourg and northern France. IX. Lejeunia N. S. 173: 1–48.
- Scholz P (2000) Katalog der Flechten und flechtenbewohnenden Pilze Deutschlands. Schriftenreihe Vegetationsk. 31: 1–298.
- Svensson M, Westberg M (2010) Additions to the lichen flora of Fennoscandia. Graphis Scripta 22: 33–37.

- Sundin R (2014) Svenska artprojektet - tolv år av spännande upptäckter. *Fauna och Flora* 109(3): 44–47.
- Søchting U, Alstrup V (2008) Danish Lichen Checklist. Ver. 2. www.bi.ku.dk/lichens/dkchecklist
- Thell A, Alstrup V, Arup U, Bendiksby M, Feuerer T, Haugan R, Kärnefelt I, Klepsland JT, Kukwa M, Launis A, Millanes AM, Motiejūnaitė J, Nordin A, Prieto M, Pykälä J, Seaward MRD, Timdal E, Tsurykau A, Vitikainen O, Westberg M (2014) New or interesting lichens and lichenicolous fungi from the Vadstena area, Östergötland, Sweden. *Graphis Scripta* 26: 15–33.
- van den Boom PPG, Etayo J, Breuss O (1995) Interesting records of lichens and allied fungi from the Western Pyrenees (France and Spain). *Cryptogamie Bryologie Lichénologie* 16: 263–283.
- van den Boom PPG, Etayo J (2000) Contribution to the knowledge of lichenicolous fungi and lichens from Portugal and Spain. *Österreichische Zeitschrift für Pilzkunde* 9: 151–162.
- Westberg M, Millanes AM, Wedin M (2008) *Tremella candelariellae* – en ny lavparasiterande basidiesvamp för Sverige. *Lavbulletinen* 2: 74–77.
- Westberg M, Thor G (2014) Lavfloran på Stora Bornö – SLF:s höstexkursion 2013. *Lavbulletinen* 2014: 19–33.
- Westberg M, Millanes A, Knudsen K, Wedin M (2015) Phylogeny of Acarosporaceae (Lecanoromycetes, Ascomycota, Fungi) and evolution of carbonized ascomata. *Fungal Diversity* 73: 145–158. doi: 10.1007/s13225-015-0325-x
- Wetmore CM (1971) The lichen family Heppiaceae in North America. *Annals of the Missouri Botanical Garden* 57: 158–209. doi: 10.2307/2395109
- Wirth V, Hauck M, Schultz M (2013) *Die Flechten Deutschlands*. Bd. 1. Ulmer, Stuttgart, 672 pp.
- Vitikainen O (2007) Nephromataceae. *Nordic Lichen Flora* 3: 91–95.
- Zamora JC, Pérez-Ortega S, Rico VJ (2011) *Tremella macrobasidiata* (Basidiomycota, Tremellales), a new lichenicolous fungus from the Iberian Peninsula. *Lichenologist* 43: 407–415. doi: 10.1017/S0024282911000405